3-1/8” ZERO180™ Gun System
Assembly and Arming Procedures

MAN-Z180-000 (R01)

Please check Owen website at
www.corelab.com/owen/ to confirm latest revision of User Manual

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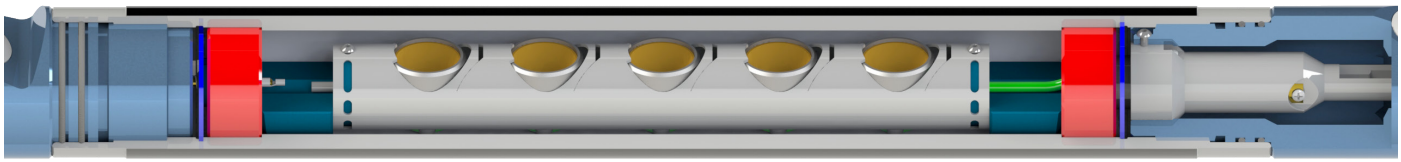

DESCRIPTION

The Owen Oil Tools Zero180 gun system provides the latest technology in oriented perforating. Designed for horizontal wells, the Zero180 system lowers completion costs and increases production results. The new generation wireline version of the Zero180 offers a patent pending electrical contact design which allows the system to rotate freely without wearing or damaging electrical connections. The shaped charges are oriented with an eccentrically weighted charge tube assembly. This patent pending weight system provides high torque to ensure accuracy of rotation and shot placement. The Zero180 system is compatible with Tubing Conveyed Perforating (TCP), Coiled Tubing, or Wireline with conventional select fire systems.

KEY FEATURES AND BENEFITS

- Orientation accuracy +/- 8%
- Uniform hole size & accurate shot placement
- Reduces break-down and treating pressures
- Simple and quick gun assembly
- Electrical contacts reduce connections and ensure free rotation
- Charge tube rotates within gun carrier - not affected by well bore debris
- No additional downhole equipment
- Quick adjustable orientation

SPECIFICATIONS

O.D.	79.375 MM	3.125”
PRESSURE RATING	144.8 Mpa	21,000 psi
TEMPERATURE	UP TO 175°C	UP TO 350°F
TENSILE STENGTH	80 070 daN	180,000 lbs
CARRIER THREAD	2.755” - 6 ACME - 3G	
TORSIONAL YIELD	4 475 N*m	3,300 lb-ft

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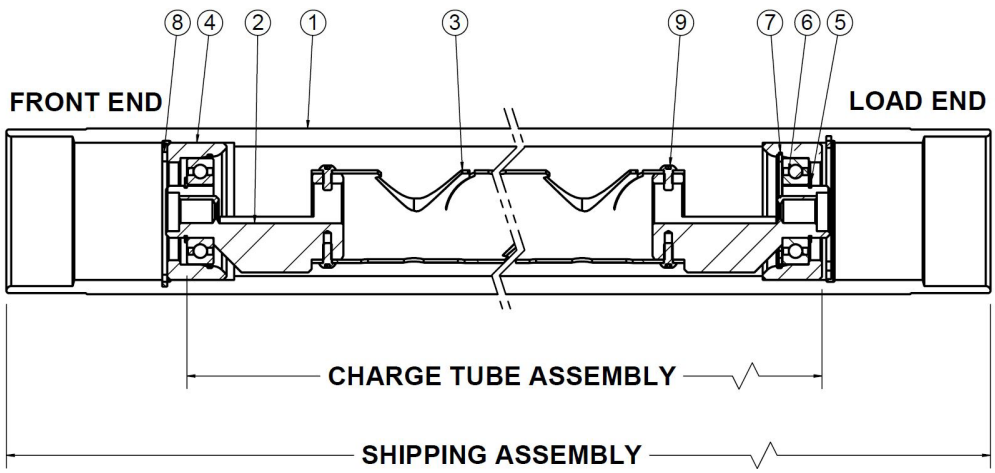
1.0 BOM and Schematic

SHIPPING ASSEMBLY COMPONENTS			
ITEM	PART NO.	DESCRIPTION	QTY.
1	ZRO-3125-(LENGTH)	3-1/8” O.D. x .313 Wall Carrier	1
2	ZRO-1750-000	Eccentric Insert	2
3	Z17-(SPF)48-(PHASE, LENGTH)	1.75” O.D. x .062” Wall Charge Tube	1
4	ZRO-3125-004	Bearing Housing	2
5	PUR-5100-100	External Retaining Ring for 1” Dia Shaft	2
6	PUR-0514-017	Double-Shielded Ball Bearing, ABEC-1, #R16	2
7	TAG-2500-075	Internal Retaining Ring for 2” Dia Bore	1
8	TAG-3125-076	Internal Retaining Ring for 3-1/8” Carrier	2
9	PF-023-016-038	#8-32 Button Head Socket Screw, 3/8” Length	4



Warning: ***Explosives are destructive by nature! Do not attempt to disassemble or alter explosive products in any manner! Do not crush, hammer, pinch, impact, pull wires or abuse any explosive product! Only personnel trained in explosive handling procedures should be allowed to arm this assembly.***

Warning: ***Used gun systems may trap pressure which can be hazardous to personnel. If the gun components trap pressure, maintain a safe distance from the carrier and slowly remove the gun sub until the o-rings are exposed and the pressure safely vents.***

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Warning: ***Always be sure to follow safe operating practices as found in API RP-67 in accordance with governmental regulations, company policies and manufacturer's recommendations!***

2.0 Pre-Assembly

Once you have obtained all the necessary hardware and explosives for your particular job application, there are a few steps that will assist you in a successful operation. For additional information on standard gun loading techniques, please refer to the Owen Oil Tools Gun Assembly Manual (MAN-Gun Assembly).

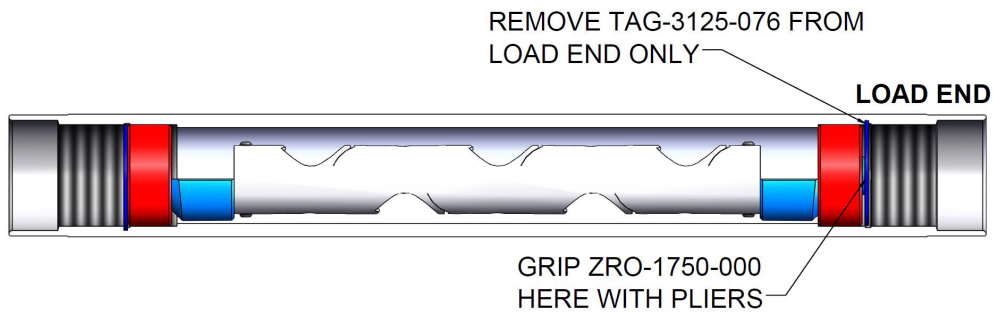
2.1 Ensure that you have the appropriate kit with the hardware assembly depending on the style of run: TCP or Wireline.

2.2 Place the gun on a loading table or workbench and remove the thread protector caps from each end.

2.3 It may also be important to mark the outside of the carriers to correspond to the amount of loaded charges. The distance from the end of the carrier to the bottom shot is specified below per shot density:

4 SPF = 7.50" from end of carrier to first shot
3.00" shot to shot

5 SPF = 7.70" from end of carrier to first shot
2.40" shot to shot



2.4 Only remove the Snap Ring (TAG-3125-076) from the Load End of the Carrier. Using a pair of pliers, gently grab the Eccentric Insert and pull the Charge Tube Assembly from the Carrier.

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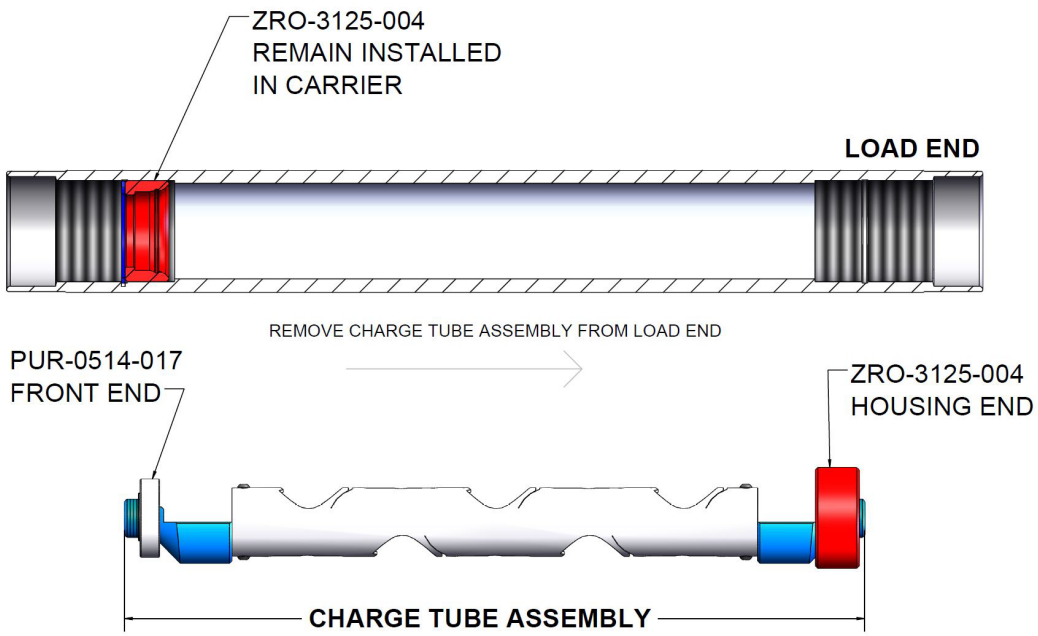
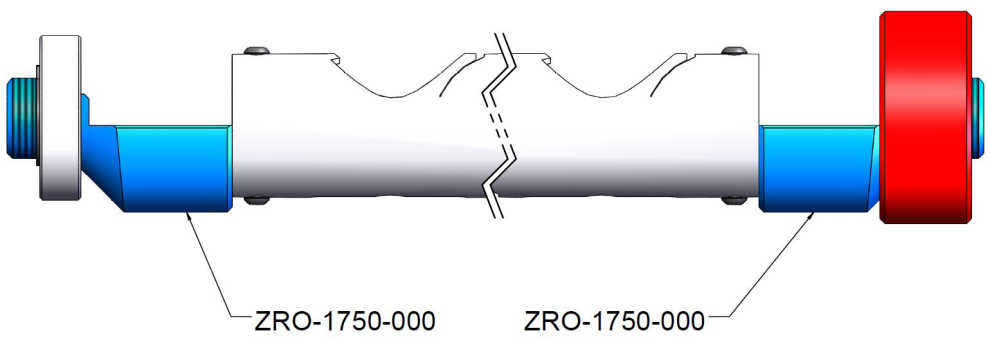


2.5 The Charge Tube Assembly will have one exposed bearing (PUR-0514-017) and one Bearing Housing (ZRO-3125-004). The second Bearing Housing will remain installed within the Carrier.

Warning: ***It is required to make an inspection of both ZRO-1750-000 parts to ensure they are installed in the same direction.***

2.6 The heavy side of both Eccentric Inserts should be installed identically on each side of the Charge Tube as shown below. The eccentric side of ZRO-1750-000 is what provides the torque to orient the Charge Tube. If either of the ZRO-1750-000 parts do not look like the graphic below, they have been installed incorrectly and the system will not function properly.

CORRECT INSTALLATION



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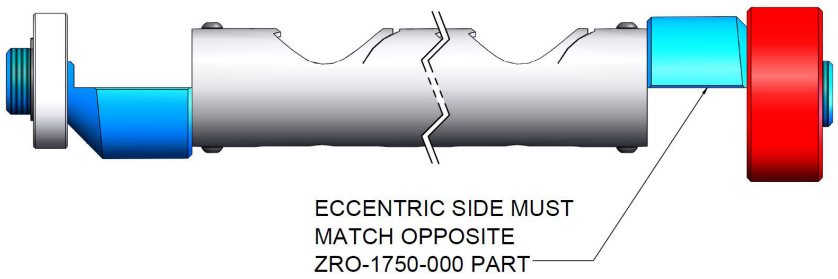
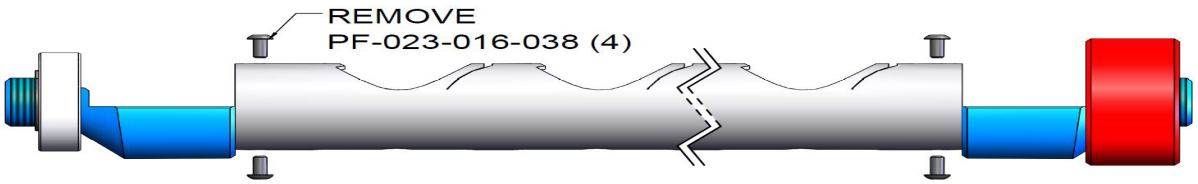
INCORRECT INSTALLATION

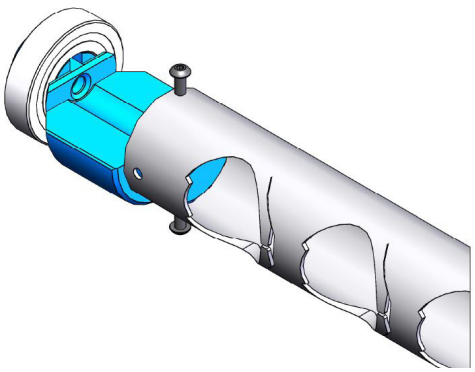


2.7 OPTIONAL STEP. The Zero180 System allows for easy shot orientation adjustment. Simply remove both sets of screws (PF-023-016-038) and rotate the Charge Tube 180 . Next, reinstall both sets of screws to ZRO-1750-000.

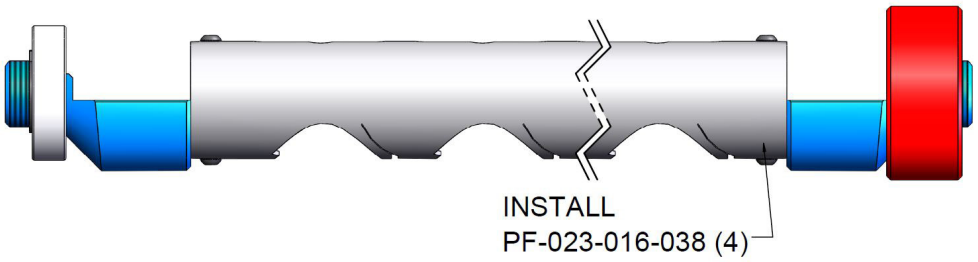
0° PHASE ORIENTATION



ROTATE CHARGE TUBE



180° PHASE ORIENTATION



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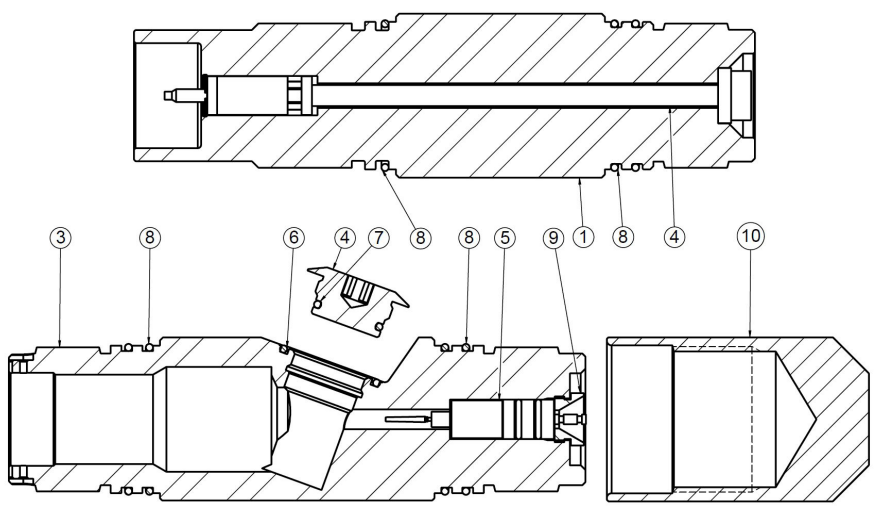
3.0 BOM - Wireline Components

WIRELINE COMPONENTS		
ITEM	PART NO.	DESCRIPTION
1	ZRO-3125-040	3-1/8” Top Contact Sub
2	AES-KIT-90028WR	Electrical Contact Redress Kit
3	TAG-3125-281SBZ	3.125” Angled Port Switch Sub
4	WT-401-0007-000	Side Port Plug W/ Dual O-ring Seal
5	SFS-0003-00N	Select Fire Switch Negative
	SFS-0003-00P	Select Fire Switch Positive
6	OOO-N569-224	224 O-ring, 90 Duro Nitrile
	OOO-V569-224	224 O-ring, 90 Duro Viton
7	OOO-N569-216	216 O-ring, 90 Duro Nitrile
	OOO-V569-216	216 O-ring, 90 Duro Viton
8	OOO-N569-230	230 O-ring, 90 Duro Nitrile
	OOO-V569-230	230 O-ring, 90 Duro Viton
9	PUR-EBRN-000	Bevel Switch Retaining Nut, 3/8” Bore
10	ZRO-3125-162	3.125” Box Bull Plug
11	ZRO-3125-000	Wireline Electrical Contact Kit*

***Detail Next Page, 1 Kit per Gun Assembly**



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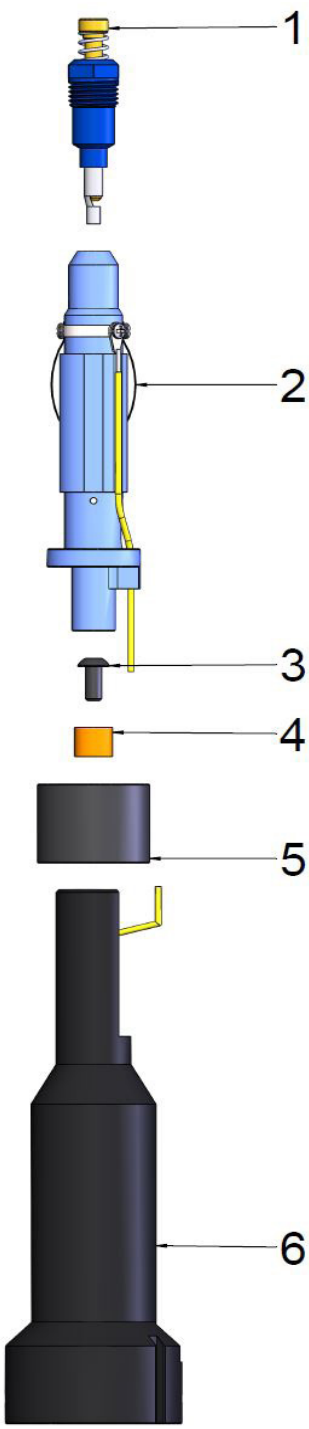
Wireline Electrical Contact Kit (ZRO-3125-000)



DESCRIPTION

The Wireline Electrical Contact Kit consists of three electrical contact components and hardware. The Contact Tube Assembly rotates with the Charge Tube Assembly while containing the detonating cord. The bow springs keep electrical contact and centralization within the Electrical Contact Housing. The Switch Contact Assembly also rotates with the charge tube assembly and allows constant contact with the select fire, feed through, or dual diode switch. Wire connections are easily installed using the provided crimp sleeve.

The electrical contact assemblies have been tested in 500 F for 8 hours. The Switch Contact Assembly (ZRO-0000-030) is also compatible with standard Own Oil Tools gun systems. All components in this kit are for 1 time use only.

WIRELINE ELECTRICAL CONTACT KIT			
ITEM	PART NO.	DESCRIPTION	QTY.
1	ZRO-0000-030	Switch Contact Assembly	1
2	ZRO-3125-010	Contact Tube Assembly	1
3	PF-023-016-038	#8-32 Button Head Socket Screw, 3/8” Length	2
4	TC-001-0003-000	Retaining Rubber Grommet	2
5	ZRO-3125-003	Contact Tube Nut	1
6	ZRO-3125-020	Contact Housing Assembly	1

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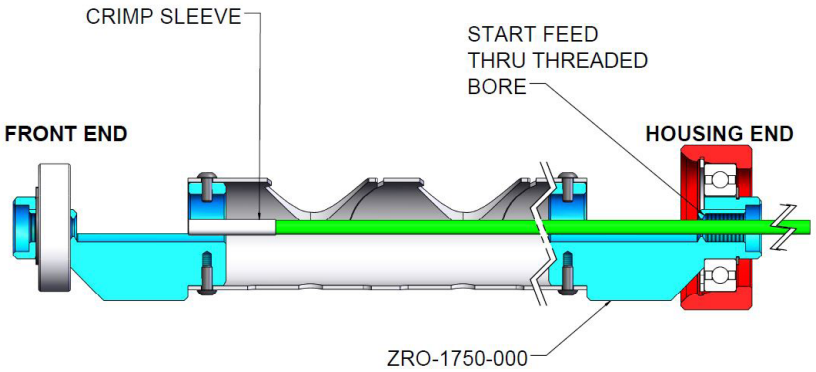
4.0 Wireline Loading Procedures

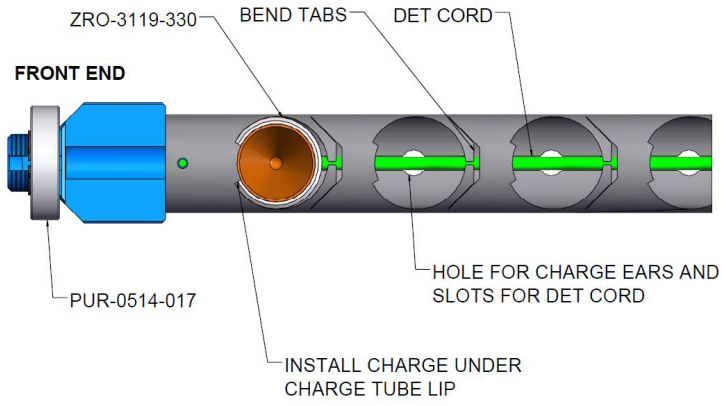
Warning: ***Never load a tube strip when the detonating cord is still attached to the roll! Cut the necessary length of cord, then remove the roll from the loading area!***

4.1 Using Owen Super Cutters, cut a sufficient length of detonating cord that will completely load your tube strip and that will allow for det cord initiation. Lay the detonating cord on the tube strip following the charge holes. Take that length and add 1 ft (.30m). It is recommended to use a crimp sleeve on the one end of the det cord. The opposite end will be used to crimp the Bi-Directional Booster.

4.2 The detonating cord is internally wrapped in the Charge Tube. Insert the detonating cord through threaded bore of the Eccentric Insert (ZRO-1750-000) at the Housing End of the Charge Tube Assembly. Continue feeding the det cord down the Charge Tube until it protrudes slightly



4.3 The Shaped Charge (ZRO-3119-330) seats all the way through the tube strip after the detonating cord has been installed. Each charge is held in place by bend tabs (Det Cord Clip not required).



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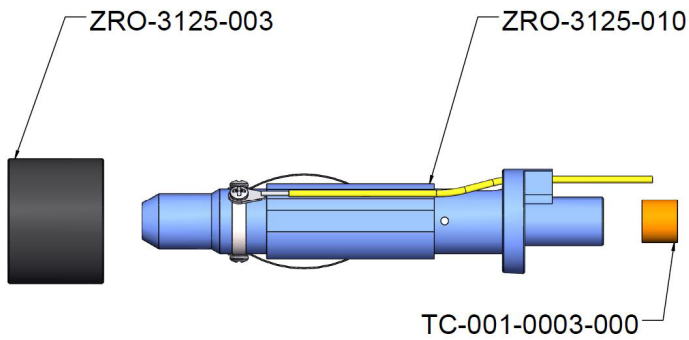
4.4 After installing the detonating cord, begin to load the shaped charges at the Front End of the charge tube assembly. Insert the charge into the large cutout hole and align the charge ears with the path of the det cord. (You may need to rotate the charge if necessary). Ensure the charge is installed under the charge tube lip as shown above.

4.5 Secure the charge in place by using a flat head screw driver to deform the bend tab to contact the metal casing of the charge. It is recommended to use both bend tabs for even weight distribution along the tube strip. After securing the bend tabs, the charge should have limited or no movement.

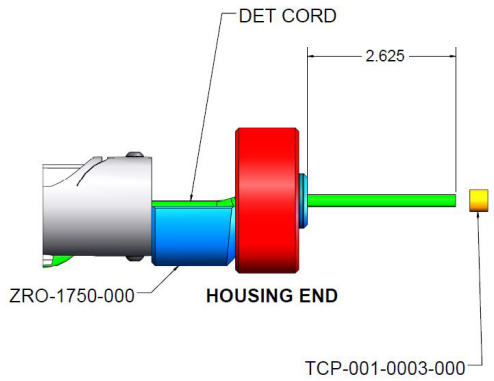
4.6 Continue installing the charges into all the remaining holes. Ensure that the detonating cord is tightly installed with each charge.

4.7 Remove the WL Contact Tube (ZRO-3125-010), Contact Tube Nut (ZRO-3125-003), and Rubber Grommet (TC-001-0003-000) from the ZRO-3125-000 Electrical Contact Kit.



4.8 At the Housing End of the charge tube assembly, hold the detonating cord slightly in tension and measure 2-5/8” of detonating cord from the nose of the Eccentric Insert (ZRO-1750-000). Once marked make a clean, squared off cut at the end of the det cord by using the Owen Super Cutters.

4.9 Install the Rubber Grommet onto the det cord and move it into the threaded bore of the Eccentric Insert component. Ensure that the grommet is flush against the back of the bore.



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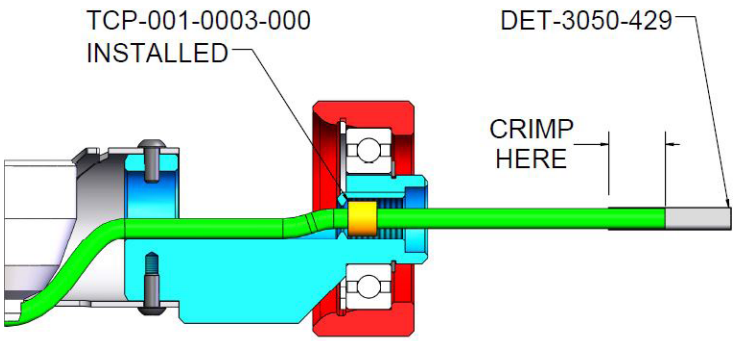
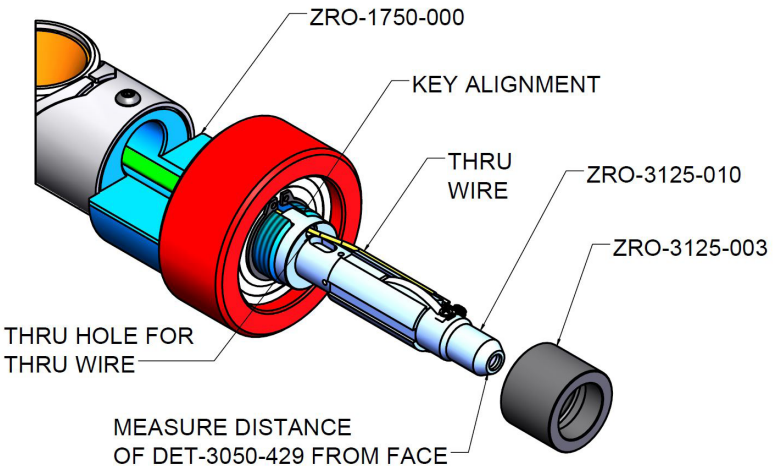
4.10 Remove the Bi-Directional Booster (DET-3050-429) from the shipping package. Install the Booster onto the end of the det cord. Crimp the Bi-Directional Booster in place using Owen Super Crimpers. Only crimp the part of the booster shell that is on the det cord.



4.11 Slide the Contact Tube (ZRO-3125-010) onto the detonating cord. Align the key on the ZRO-3125-010 with the key way on the Eccentric Insert. Next, slide the Contact Tube Nut (ZRO-3125-003) over the Contact Tube (ZRO-3125-010) and thread onto the nose of the Eccentric Insert. Thread until grommet compresses and nut is hand tight. The wire attached to the Contact Tube should be inserted through the hole as shown. This will be the connection to the thru wire. **The bidirectional booster should be no more than 1/4" from the face of the Contact Tube.**



4.12 Remove the Switch Contact Assembly (ZRO-0000-030) from the Electrical Contact Kit. Using wire cutters, cut a sufficient length of 22 Gauge, 19 strand, Teflon insulated wire. Cut at least the length of the entire Charge Tube Assembly. Strip the insulation on one end of the wire about 1". Feed the wire into the Snap- Plug Terminal on the Switch Contact Assembly then crimp. It is recommended to use a flexible insulation over the crimped connection.

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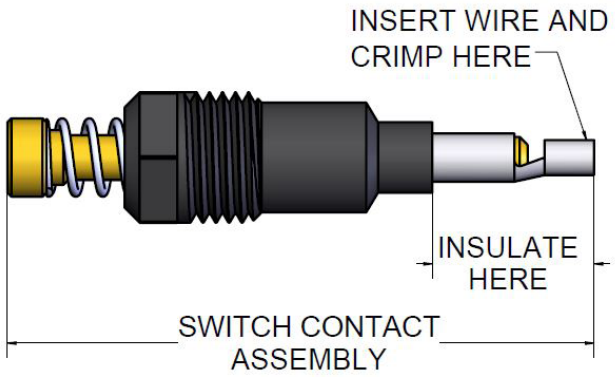
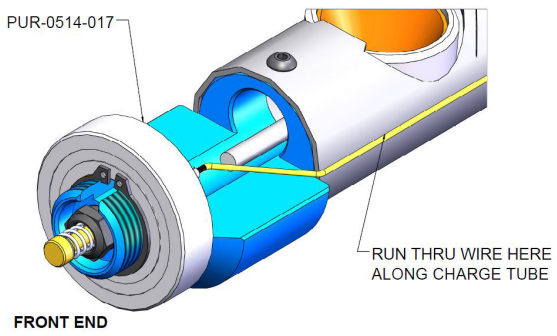
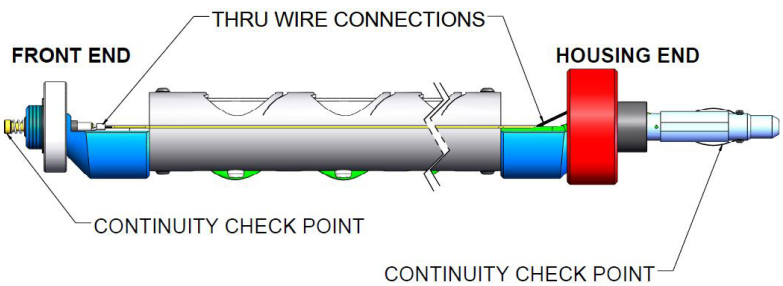


4.13 Insert the 22 gauge wire through the Front End of the Eccentric Insert bore, then thread Switch Contact Assembly in the Eccentric Insert as shown. Use a 1/2” socket head to tighten the assembly until it stops - do not over tighten. Run the thru wire along the side of the Charge Tube and tape it to the tube in between each charge. 1/8” O.D. tubing insulation is optional to run the wire through along the charge tube.



4.14 After running the thru wire along the Charge Tube and securing it, make the connection at the Housing End of the assembly with the Contact Tube wire. It is recommended to use proper insulation around the exposed wire. After making the proper connections, use a multimeter to check the continuity from the Contact Pin of the Switch Contact Assembly (ZRO-0000-030) to the Bow Spring of Contact Tube.



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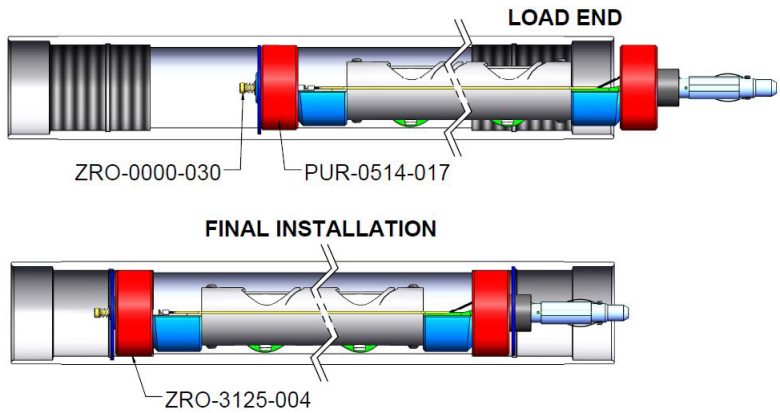
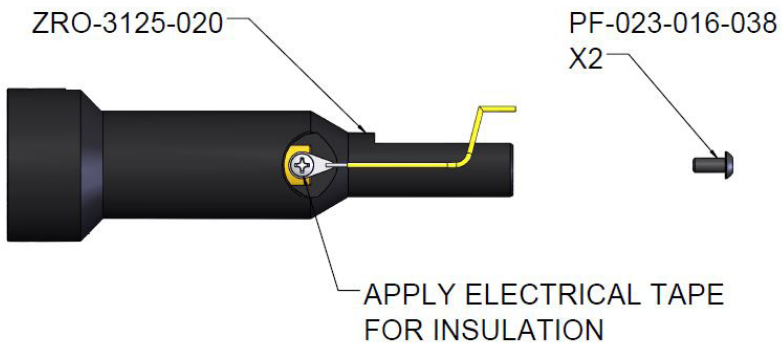
4.15 Make a final inspection of the Charge Tube, det cord, wire connections, and insulations. Ensure that the charges are tightly seated in the tube and no bend tabs are protruding above the Charge Tube O.D. Also inspect the wire and det cord to make sure there are no nicks, cuts, or exposed wires. Make sure both Eccentric Inserts are installed in the same orientation (Refer to Pre-Assembly Section of Manual).

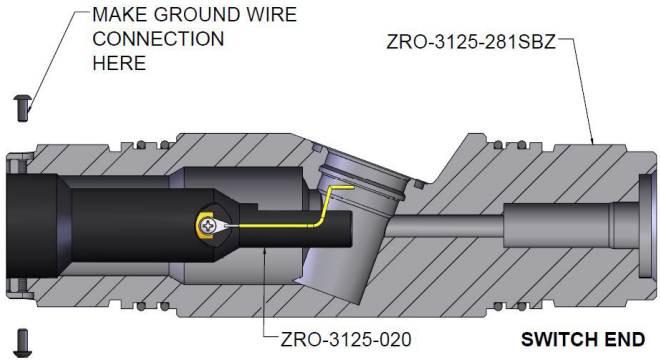
4.16 Install the Charge Tube Assembly back into the carrier. The Front End (the end with PUR-0514-017 and ZRO-0000-030) will be loaded first into the carrier. Slide the assembly through the carrier until PUR-0514-017 is correctly seated in ZRO-3125-004 at the Front of the carrier. After seated correctly, reinstall the Snap Ring (TAG-3125-076) at the Load End of the carrier. Ensure that the assembly is able to rotate freely within the carrier.



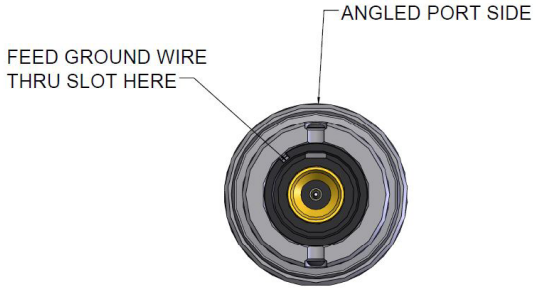
4.17 Remove the Contact Housing (ZRO-3125-020) and #8-32 Socket Head Button Screws (PF-023-016-038) from the Electrical Contact Kit (ZRO-3125- 000). It is recommended to apply a wrap of electrical tape to the exposed brass to avoid contact with the ground wire.



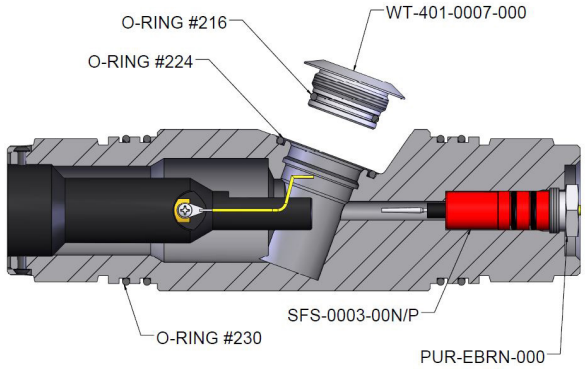
4.18 Insert the Contact Housing (ZRO-3125-020) into the Owen Angled Port Switch Sub (ZRO-3125-281SBZ). Concentrically align the large O.D. of the Contact Housing with the I.D. of the sub and install. Next, align the tapped holes on the sub with the holes in the Contact Housing. Make the ground wire attachment to the top screw (PF-023-016-038) before threading the screw into the sub.



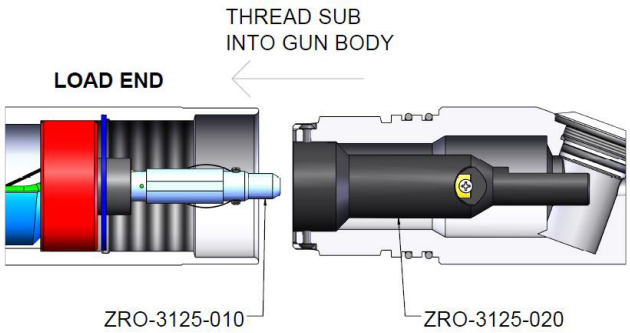
4.19 After installing the Contact Housing (ZRO-3125-020), feed the ground wire through the slot in the Housing. If the slot is not in the position shown below, the Housing has been installed incorrectly. Ensure that the ground wire can be accessed through the angled port for later connections.



4.20 Install the appropriate switch and retaining nut according to standard procedures into the switch bore. Install the proper o-rings onto the sub and the face seal port.



4.21 To install the subs into the gun carriers, apply grease to the o-rings and threads. Thread the sub into the carrier load end (end with the Contact Tube). Ensure that the Contact Housing (ZRO-3125-020) is the end of the sub being threaded. Complete the string by installing the Front End of the gun bodies to the switch end of the Tandem Sub. Refer to MAN-TGS1-000 for required minimum/maximum torque values for sub installation.



Warning: ***If any difficulty is encountered while inserting the tandem sub, STOP and check for the cause of the difficulty! If necessary, remove the tandem sub from the gun body and determine the problem!***

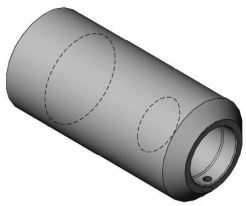
Note: *It is recommended to check the continuity of the thru wire and electrical connections of the entire gun string at this time. Check each gun individually then check the string from the Top Contact Sub to the bottom gun.*

4.22 The Zero180 Wireline Gun System requires the Owen Top Contact Sub (ZRO-3125-040). The Top Contact Sub eliminates any wire connections and allows the top gun to freely rotate within the carrier. The Top Contact Sub is compatible with a 3-1/4" Quick Change Assembly. If you are running a setting tool and plug, use the Owen Plug and Shoot Adaptor (TAG-3125-073) on the bottom Tandem sub. If not, use the Box Bull Plug on the bottom Tandem Sub (ZRO-3125-162).

ZRO-3125-040

ZRO-3125-162

TAG-3125-073



5.0 Wireline Arming Procedures

Warning: ***Explosives are destructive by nature! Do not attempt to disassemble or alter the detonator in any manner! Do not crush, hammer, pinch, impact, pull wires or abuse the detonator or any explosive! 5.0 Wireline Arming Procedures Zero180 System***

Warning: ***Be sure to follow safe operating practices as found in API RP-67 in accordance with governmental regulations, company policies and manufacturer's recommendations!***

Warning: ***Detonators should be removed from their packaging and storage in the loading/arming area at the time of arming! Always insert the detonator inside a safety tube after removal from packaging and storage!***

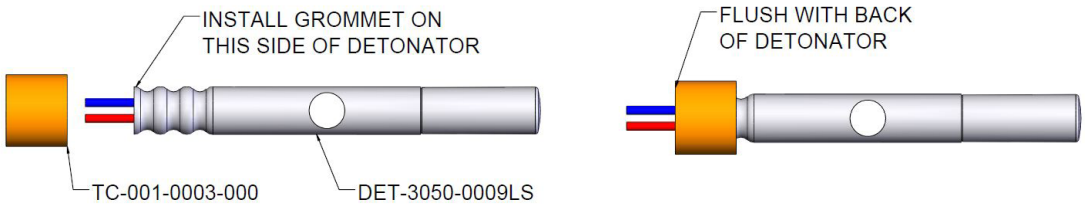
Caution: ***It is recommended to handle one detonator at a time to minimize the hazards; furthermore, arm each gun individually from the top of the gun string working towards the bottom to reduce exposure and risk.***

The following steps are recommended to be completed prior to commencing the arming procedures:

- Hazard Identification and Resolution
- Safety Meeting
- Stray Voltage Check
- Installation of grounding cables
- Check Fire through logging equipment (not perforating equipment)
- Power down all power sources and rf devices
- Remove safety key from inside of WL operating unit
- Attach perforating equipment to the WL cable
- Verify no voltage exists at the electrical connections of the gun

Caution: ***DO NOT PULL ON THE DETONATOR WIRES.***

5.1 Remove the Owen 009LS Detonator (DET-3050-009LS) from the shipping container and package. Also remove the final Rubber Grommet (TC-001-0003- 000) from the Electrical Contact Kit (ZRO-3125-000). Install the Rubber Grommet onto the end of the 009LS detonator.



5.2 Insert the Detonator into a Detonator Safety Tube and secure the lid closed.

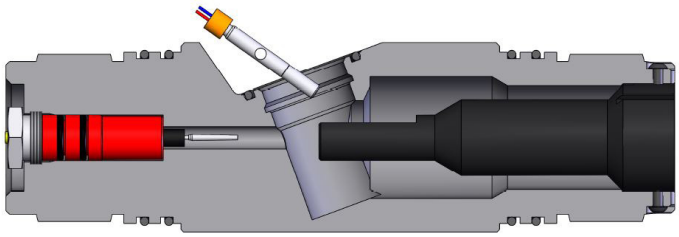
5.3 Remove the electrical shunt from the wires and verify the resistance of the meter with a blaster's multimeter or blaster's galvanometer.

5.4 Through the angled port, electrically connect the ground wire of the gun to the blue wire of the detonator. No insulation is necessary for the ground connection. Keep the wires as short as possible to allow room for all connections in the port and prevent nicked or cut wires.

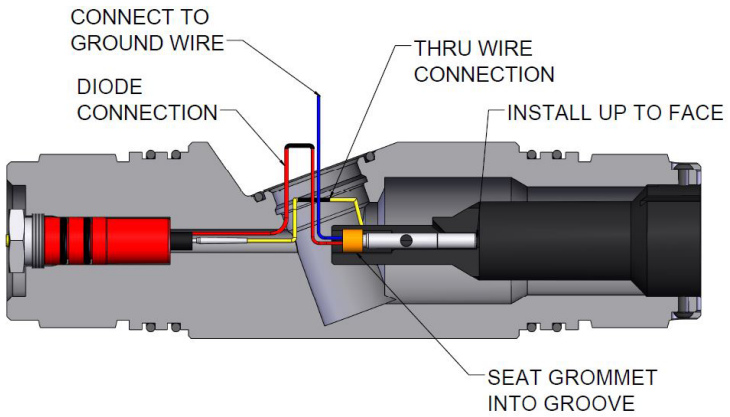
5.5 Through the angled port, electrically connect and insulate the hot wire from the switch/dual diode to the red wire of the detonator. Keep the wires as short as possible to allow room for all connections in the port and prevent nicked or cut wires.

5.6 Finally, connect the thru wire from the Contact Housing (ZRO-3125-020) to the thru wire from the switch/dual diode. Keep the wires as short as possible to allow room for all connections in the port and prevent nicked or cut wires.

5.7 The detonator is now electrically connected. Remove the detonator from the safety tube. Inspect all the connections and ensure all wires are fully insulated. Install the detonator as shown below. Insert into the angled port at a slight angle and seat the grommet into the groove of the Contact Housing.

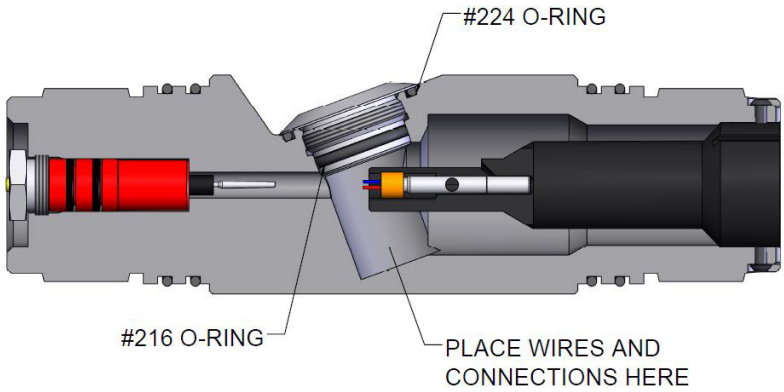


Caution: ***DO NOT PULL ON THE DETONATOR WIRES.***

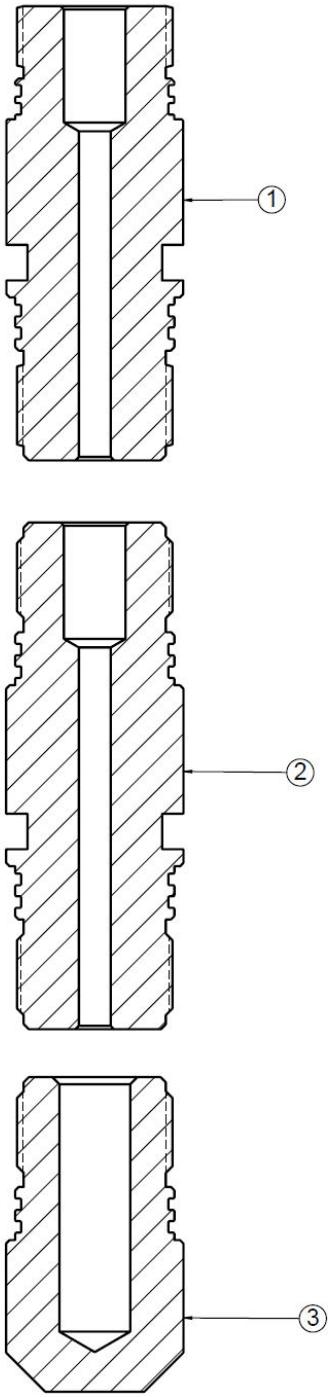


5.8 After installing the detonator into the Housing, carefully tuck the connections and wires into the open area of the angled port. Ensure all the wires and connections are placed below the threads of the port plug. Make a final inspection of the connections and wires.

5.9 Ensure the proper o-rings are installed on the sub and port. Apply grease to the threads and to the o-rings. Thread the port plug into the angled port and tighten. Make sure not to bind, cut, or nick the wires or connections.

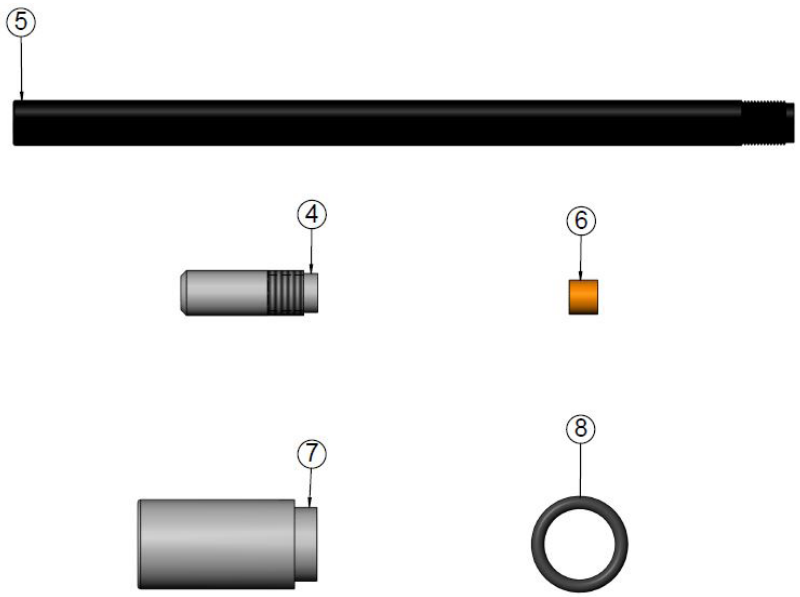


6.0 BOM - TCP Components



TCP COMPONENTS		
ITEM	PART NO.	DESCRIPTION
1	TAG-3125-280	3-1/8" Top Sub
2	TAG-3125-281	3-1/8" Standard Tandem Sub
3	TAG-3125-162	3-1/8" Bull Plug
4	OOO-N569-230	230 O-ring, 90 Duro Nitrile
	OOO-V569-230	230 O-ring, 90 Duro Viton
TCP BOOSTER TRANSFER KIT*		
ITEM	PART NO.	DESCRIPTION
5	TCP-0100-247	TCP Booster Retainer
6	TCP-0100-271	Booster Tube
7	TC-001-0003-000	Retaining Rubber
8	TCP-0100-263	Alignment Insert
9	OOO-N569-211	211 O-ring, 90 Duro Nitrile

***TAG-0100-040 & TCP-0100-356 Not Required in this Assembly**

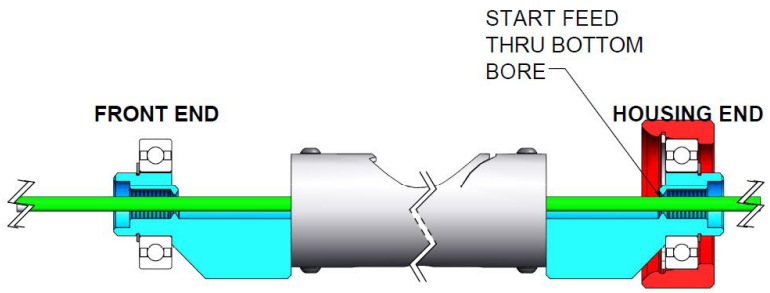


7.0 TCP Loading Procedures

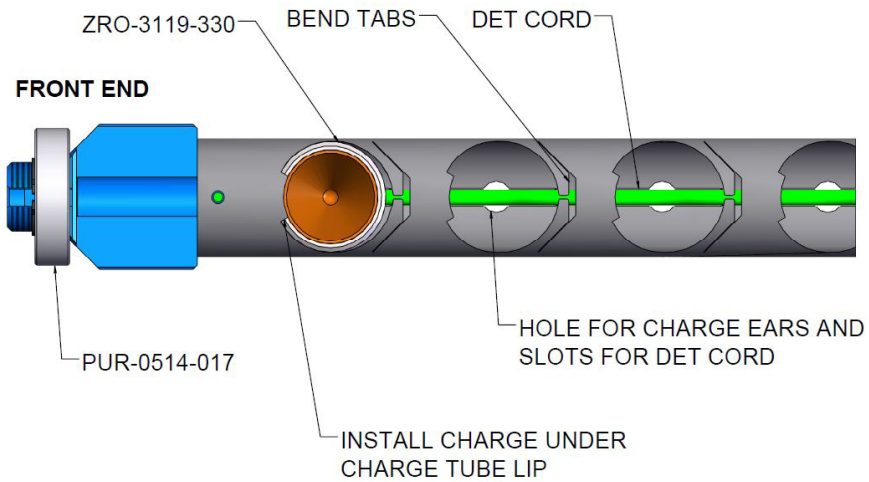
Warning: ***Never load a tube strip when the detonating cord is still attached to the roll! Cut the necessary length of cord, then remove the roll from the loading area!***

7.1 Using Owen Super Cutters, cut a sufficient length of detonating cord that will completely load your tube strip and that will allow for det cord initiation. Lay the detonating cord on the tube strip following the charge holes. Take that length and add 1 ft (.30m).

7.2 The detonating cord is internally wrapped in the Charge Tube. Insert the detonating cord through the Eccentric Insert (ZRO-1750-000) through the threaded bore at the Housing End of the Charge Tube Assembly. Continue feeding the det cord down the Charge Tube until it protrudes at least 1 ft. through the bore of Eccentric Insert at the opposite end of the Charge Tube.



7.3 The Shaped Charge (ZRO-3119-330) seats all the way through the tube strip after the detonating cord has been installed. Each charge is held in place by bend tabs (Det Cord Clip not required).

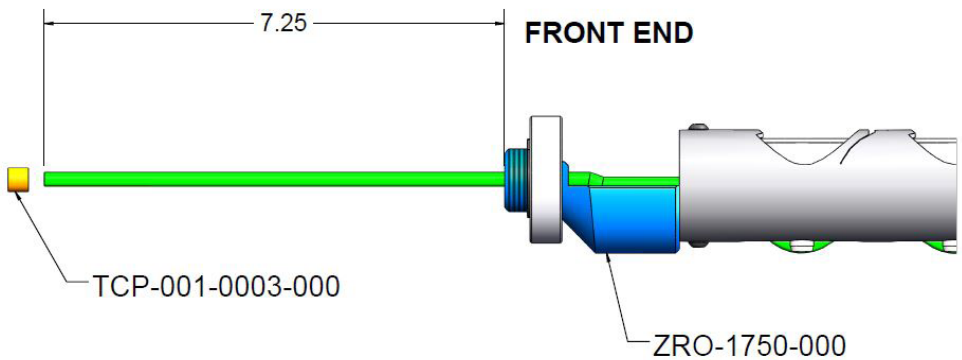


7.4 After installing the detonating cord, begin to load the shaped charges at the Front End of the charge tube assembly. Insert the charge into the large cutout hole and align the det cord ears with the path of the det cord. (You may need to rotate the charge if necessary). Ensure the charge is installed under the charge tube lip as shown above.

7.5 Secure the charge in place by using a flat head screw driver to deform the bend tab to contact the metal casing of the charge. It is recommended to use both bend tabs for even weight distribution along the tube strip. After securing the bend tabs, the charge should have limited or no movement.

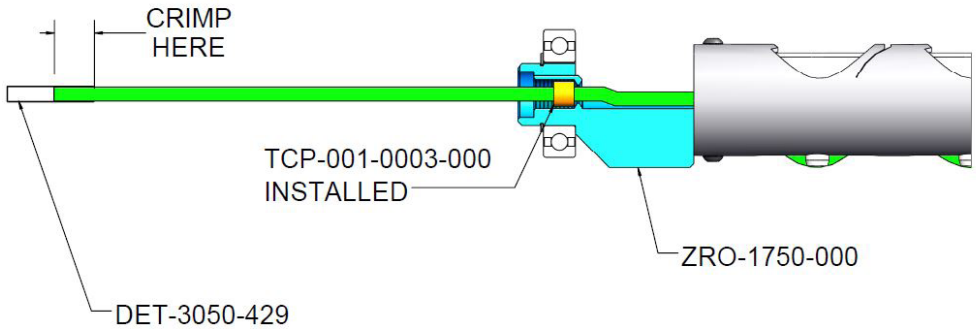
7.6 Continue installing the remaining charges. Ensure that the detonating cord is tightly installed with each charge.

7.7 At the Front End of the charge tube assembly, hold the detonating cord slightly in tension and measure 7-1/4” of detonating cord from the nose of the Eccentric Insert (ZRO-1750-000). Once marked make a clean, squared off cut at the end of the det cord by using the Owen Super Cutters.



7.8 Remove both Rubber Grommets (TCP-001-0003-000) from the TCP Booster Transfer Kit (TCP-0100-275). Install one Rubber Grommet onto the det cord and move it into the threaded bore of the Eccentric Insert (ZRO-1750-000). Ensure that the grommet is flush against the back of the bore.

7.9 emove the Bi-Directional Booster (DET-3050-429) from the shipping package. Install the Booster onto the end of the det cord. Crimp the Booster in place using Owen Super Crimpers.



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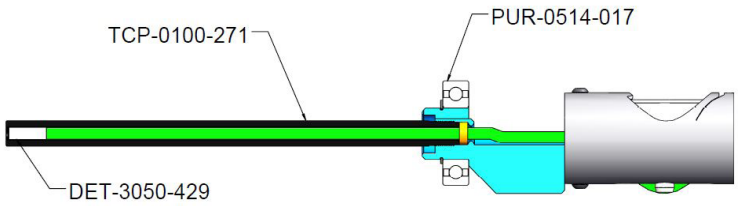
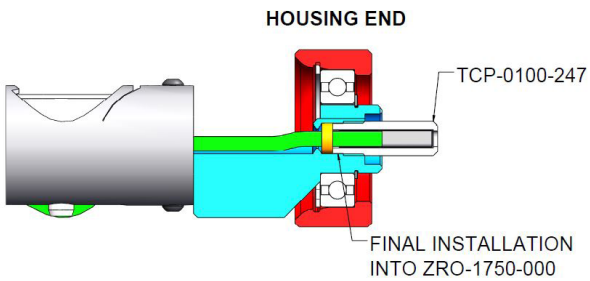
7.10 Remove the long Booster Tube (TCP-0100-271) from the TCP Booster Transfer Kit (TCP-0100-275). Insert the detonating cord with the Bi-Directional Booster into the Booster Tube and thread into the Eccentric Insert (ZRO-1750- 000). Firmly tighten with hand only.



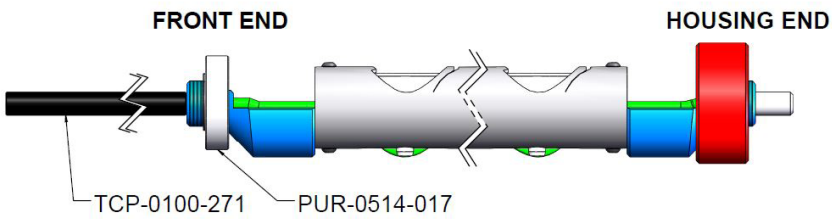
7.11 At the Housing End of the Charge Tube Assembly, cut the detonating cord at the nose of the Eccentric Insert. Then remove the det cord from the Eccentric Insert bore to install the bi-directional booster.

7.12 Crimp the Bi-Directional Booster in place using Owen Super Crimpers. Only crimp the part of the booster shell that is on the det cord. Re-install the det cord and Booster back through the Eccentric Insert bore. Install the remaining Rubber Grommet on to the det cord and slide down the cord into the bore of the Eccentric Insert.

7.13 Remove the short Booster Tube (TCP-0100-247) from the TCP Booster Transfer Kit. Install the Booster Tube onto the det cord and Booster as shown. Thread into the Eccentric Insert bore and firmly hand tighten.



7.14 Make a final inspection of the Charge Tube and detonating cord. Ensure that the charges are tightly seated in the tube and no bend tabs are protruding above the Charge Tube O.D. Make sure there are no nicks in the det cord and both Boosters are installed. **Make sure both Eccentric Inserts are installed in the same orientation (Refer to Pre-Assembly Section of Manual).**



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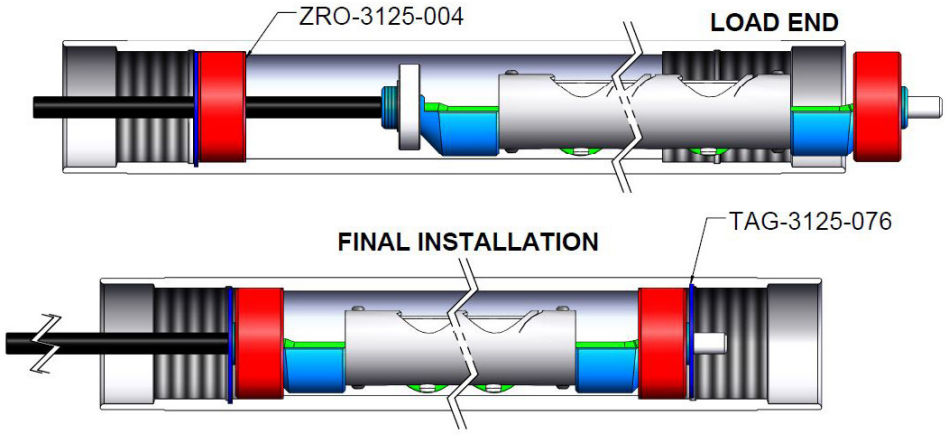
7.15 Install the Charge Tube Assembly back into the carrier. The Front End (the end with PUR-0514-017 and TCP-0100-271) will be loaded first into the carrier. Slide the assembly through the carrier until PUR-0514-017 is correctly seated in the Bearing Housing (ZRO-3125-004) at the Front of the carrier. After seated correctly, reinstall the snap ring at the Load End of the carrier. Ensure that the assembly is able to rotate freely within the carrier.



Warning: ***If any difficulty is encountered while inserting the tube strip, STOP and check for the cause of the difficulty! If necessary, pull the tube strip back out of the carrier and determine the problem! Never beat or force a loaded tube strip into a carrier!***

7.16 Install the alignment insert (TCP-0100-263) and o-ring (OOO-N569-211) into each tandem or top sub. Apply the correct 230 o-rings to each tandem sub, top sub, and bull plug. Apply grease to the threads and o-rings of each connection.

7.17 Thread the subs onto the top of each gun ensuring TCP Booster Retainer (TCP-0100-271) does not get damaged or bent. Tighten each connection. Refer to **MAN-TGS1-000** for required minimum/maximum torque values for sub installation.

Caution: ***Do not damage or break the Booster Transfer Tube during insertion! Do not pinch the det cord or Booster during insertion!***

Warning: ***If any difficulty is encountered while inserting the tandem sub, STOP and check for the cause of the difficulty! If necessary, remove the tandem sub from the gun body and determine the problem!***

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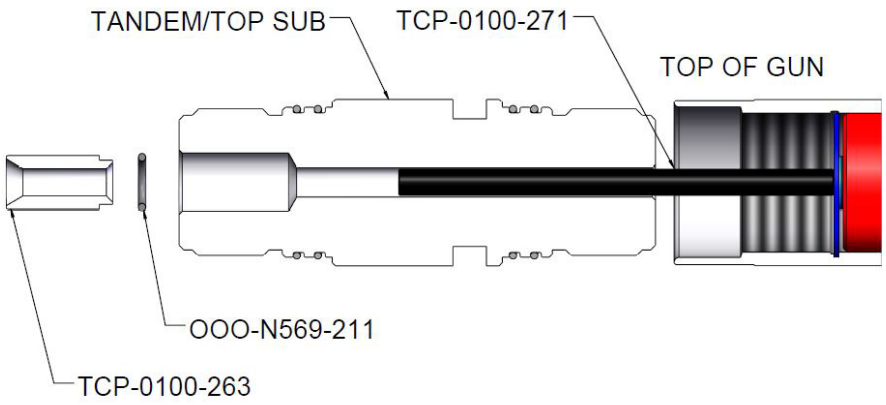

7.18 Perform additional actions to prepare guns for storage or transportation.

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